TITLE OF THE INVENTION

MULTIMEDIA INFORMATION COMMUNICATION APPARATUS AND
METHOD

5   CROSS-REFERENCE TO THE RELATED APPLICATION

This application is a continuation of
International Application No. PCT/JP00/02598,
whose international filing date is April 20, 2000,
the disclosures of which Application are

10   incorporated by reference herein.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention generally relates

15   to multimedia information communication
apparatuses such as a portable visual telephone
and a digital broadcast receiver and to methods
employed therein. More particularly, the present
invention relates to a multimedia information

20   communication apparatus and method in which a
multiplexed coded bit stream carrying video data
and audio data is received and demultiplexed in a
media demultiplexer, the video data being output
to a video decoder and the audio data being output

25   to an audio decoder so that the coded video data
and audio data are decoded.

2. Description of the Related Art

Japanese Laid-Open Patent Publication No.
8-204584 and Japanese Laid-Open Patent Publication

30   No. 8-65278 disclose multimedia information

communication apparatuses in which an error in the video data carried in the bit stream is detected only when the video data is decoded by the video decoder in a decoding circuit in a decoding unit.

5   A description will now be given of the procedure for error detection in the related-art multimedia information communication apparatus.

Fig. 8 shows a construction of MPEG4 (ISO/IEC Standard 14496-2) video data that is
10   carried in a coded bit stream in a multiplex format.

The MPEG4 standard is designed to provide a reinforced tolerance to error in a coded bit stream in order to enable image communication
15   over channels such as a wireless channel and the Internet characterized by difficulty in guaranteeing the quality of communication. Ordinary MPEG4 video data is constructed in units known as a video packet (VP) 100 as shown in Fig.
20   8. Referring to Fig. 8, a video packet 100 is comprised of a Resync Marker (RM) 101, a video packet header 102, macro block (MB) coded information 103 and a stuff bit 104 at the end.

The Resync Marker 101 comprises a unique
25   bit pattern that does not match any of the combinations of variable-length codes that occur in the bit stream. The Resync Marker 101 is provided to prevent an error from being propagated when the bit stream is decoded. In case of an
30   error, the video decoder resumes decoding of the

video packet properly at a position at which the Resync Marker 101 is detected as a synchronous word. The video packet header 102 next to the Resync Marker 101 includes important information

5   required in decoding the video data. The macro block (MB) coded information 103 is coded information for each macro block (MB) constituting a unit used in encoding of video data at the encoding end. The stuff bit 104 at the end is

10 inserted for byte alignment of the Resync Marker 101 in the bit stream.

A description will now be given of a process for locating an ordinary error when the MPEG4 video data is decoded. Decoding of the

15 video data is started at the Resync Marker 101 to proceed in a forward direction until an error is detected. Subsequently, decoding of the video packet is resumed at the stuff bit 104 in a reverse direction until an error is detected.

20   According to the related-art multimedia information communication apparatus as described above, error correction in the video data is conducted only when the data is decoded by a decoding circuit. A disadvantage of this

25 arrangement is that the decoding process conducted until the error is detected is wasted so that the subsequent process for preventing error propagation cannot be performed efficiently.

SUMMARY OF THE INVENTION

Accordingly, a general object of the present invention is to provide a multimedia information communication apparatus in which the aforementioned disadvantage is eliminated.

Another and more specific object of the invention is to provide a multimedia information communication apparatus in which the decoding process is not wasted in case of an error and in which a process for preventing error propagation is performed efficiently.

The aforementioned objects can be achieved by a multimedia information communication apparatus for dissolving, at a data demultiplexing, a multiplexed coded bit stream into video data and audio data, the video data having attached thereto an error correction character produced at an encoding end in accordance with a predetermined error correction calculation, and for decoding the video data and the audio data by outputting the video data to a video decoder and outputting the audio data to an audio decoder, wherein the media demultiplexer comprises: demultiplexing means for dissolving the coded bit stream into the video data and the audio data; error correction character generating means for receiving the video data from the demultiplexing means and subjecting same to the predetermined error correction calculation; error information adding unit for comparing a result of calculation by the error

correction character generating means with the
error correction character attached to the video
data, and for attaching error information based on
a result of comparison to the video data, and

5   wherein the video decoder decodes the video data
by referring to the error information attached to
the video data by the error information adding
unit.

    The multimedia demultiplexer may further

10   comprise error correction character isolating
means for receiving the video data from the
demultiplexing means, isolating the error
correction character from the video data, and for
outputting video data stripped of the error

15   correction character to error information adding
unit.

    The coded bit stream may conform to the
standard video data compressing and encoding
system specified in the ITU-T Recommendation and

20   the ISO/IEC Standard.

    The coded bit stream may be an MPEG4
(ISO/IEC Standard 14496-2) bit stream specified in
the ITU-T Recommendation and the ISO/IEC Standard
describing a video compression and encoding system,

25   and each video packet in the video data
constituting an MPEG4 data transfer unit may have
attached thereto an error correction character
generated at the encoding end in accordance with
the predetermined error correction calculation;

30   the error correction character generating means in

the media demultiplexer may subject each video
packet to the predetermined error correction
calculation; and the error information adding unit
in the media demultiplexer may compare a result of
5   calculation in each video packet by the error
correction character generating means with the
error correction character attached to each video
packet in the video data, and attach error
information based on a result of comparison to
10   each video packet in the video data.

The error information adding means may
add the error information at the end of each video
packet in the video data.

The error information adding means may
15   add the error information that starts with a
fixed-length code comprising a unique bit pattern
to each video packet in the video data.

The aforementioned objects can also be
achieved by a multimedia information communication
20   method for dissolving a multiplexed coded bit
stream into video data and audio data, the video
data having attached thereto an error correction
character produced at an encoding end in
accordance with a predetermined error correction
25   calculation, and for decoding the video data and
the audio data, comprising steps of: receiving the
coded bit stream and dissolving same into video
data and audio data so as to subject the video
data to the predetermined error correction
30   calculation; comparing a result of calculation

with the error correction character attached to

the video data, and adding error information based

on a result of comparison to the video data; and

decoding the video data by referring to the error

5   information attached to the video data.

BRIEF DESCRIPTION OF THE DRAWINGS

Other objects and further features of

the present invention will be apparent from the

10   following detailed description when read in

conjunction with the accompanying drawings, in

which:

Fig. 1 is a block diagram of a

multimedia information communication apparatus

15   according to a first embodiment of the present

invention;

Fig. 2 is a diagram showing a

construction of and a process performed in a media

demultiplexer according to the first embodiment;

20   Fig. 3 is a diagram showing how a video

packet is revised in the media demultiplexer

according to the first embodiment;

Fig. 4 is a diagram showing a revised

video packet in which error information is added

25   by an error information adding unit according to

the first embodiment;

Fig. 5 is a diagram showing a revised

video packet in which error information is added

by an error information adding unit according to a

30   second embodiment of the present invention;

Fig. 6 is a diagram showing a location and configuration of error information added by an error information adding unit according to a third embodiment of the present invention;

5   Fig. 7A is a diagram showing the error information according to the first embodiment in which the construction of error information according to the third embodiment is employed;

Fig. 7B is a diagram showing the error
10   information according to the second embodiment in which the construction of error information according to the third embodiment is employed; and

Fig. 8 is a diagram showing an example of construction of MPEG video data carried in a
15   coded bit stream in a multiplex format.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS
First Embodiment

Fig. 1 is a block diagram of a
20   multimedia information communication apparatus according to a first embodiment of the present invention. Fig. 1 is derived from ITU-T Audiovisual/Multimedia (H series) Recommendation (Shin Nippon ITU Society), Attachment D,
25   "Information Supplying Purpose", showing a transmitter and a receiver of a multimedia information communication apparatus.

Referring to Fig. 1, the transmitter comprises: a video encoder 1 for compressing and
30   encoding image; an audio encoder 2 for compressing

and encoding the audio data; a media multiplexer 3
for multiplexing an output video encoded bit
stream and an output audio encoded bit stream; and
buffers 7a and 7b. The receiver comprises: a media
5   demultiplexer 4 for demultiplexing the multiplexed
information; a video decoder 5 for decoding the
video data; an audio decoder 6 for decoding the
audio data; and buffers 7c and 7d. The novel
feature of the multimedia information
10   communication apparatus according to the present
invention consists in the construction of the
receiver, not the transmitter. More specifically,
the novelty resides in the fact that the receiver
includes the media demultiplexer and the video
15   encoder described below.

An image encoding system to which the
present invention is applied may be any standard
encoding method specified in ITU-T Recommendations,
ISO/IEC Standards. It is assumed that the
20   invention according to the first embodiment
described below is applied to MPEG4 (ISO/IEC
Standard 14496-2).

A description will now be given of a
construction of and a process in the media
25   demultiplexer according to the first embodiment.

Fig. 2 shows a construction of and a
process performed in the media demultiplexer 4.

As shown in Fig. 2, the media
demultiplexer 4 according to the first embodiment
30   comprises a data demultiplexer 41, a CRC character

isolating unit 42, a CRC calculating unit 43 and
an error information adding unit 44. Referring to
Fig. 2, the media demultiplexer 4 is shown to be
comprised of hardware members. The present

5   invention may also be constructed such that the
function of each of the units is implemented by
software means, that is, by a program.

Referring again to Fig. 2, a description
will be given of the operation of the media

10   demultiplexer 4 according to the first embodiment.

The coded bit stream is received by the
apparatus and input to the media demultiplexer 4.
The data demultiplexer 41 identifies the packet
header (PH) of the packet carried in the coded bit

15   stream in a multiplex format so as to determine if
the packet is a video packet (VP) 100 or an audio
packet (AP) 200 and to isolate the video packet
(VP) 100 from the audio packet (AP) 200. The data
demultiplexer 41 then outputs the video packet

20   (VP) 100 to the CRC character isolating unit 42
and outputs the audio packet (AP) 200 to the
buffer 7d of the audio decoder 6. At this stage,
the configuration of the video packet (VP) 100 is
the same as an ordinary MPEG4 video packet shown

25   in Figs. 7A and 7B.

The CRC character isolating unit 42
receives the video packet (VP) 100 output from the
media demultiplexer 4 so as to strip each video
packet (VP) 100 of a CRC character. The CRC

30   character isolating unit 42 outputs the isolated

CRC character to the error information adding unit 44. The CRC character isolating unit 42 outputs isolated video packet to the CRC calculating unit 43 and the error information adding unit 44. As shown in Fig. 3, each of the video packets has appended to its end a cyclic redundancy check (CRC) character generated at the encoding (transmitting) end by subjecting specific data of the video data to a calculation that uses a predetermined polynomial.

The CRC calculating unit 43 receives the video packet stripped of the CRC character in the order of occurrence and subjects the video packet to the same calculation used at the encoding (transmitting). The CRC calculating unit 43 outputs the result of calculation to the error information adding unit 44.

The error information adding unit 44 stores the video packet and the CRC character isolated from each other by the CRC character isolating unit 42 in an internal buffer (not shown) or in an internal memory (not shown). When the result of calculation using the same algorithm used at the encoding (transmitting) end is fed from the CRC calculating unit 43, the error information adding unit 44 reads the CRC character stored in the internal buffer (not shown) or the like. The error information adding unit 44 compares the result of calculation with the CRC character thus read so as to determine if they

match. When a determination is given, the error

information adding unit 44 reads out the video

packet stripped of the CRC character and stored in

the internal buffer or the like. The error

5   information adding unit 44 then adds error

information indicating the determination to the

video packet thus read out. The resultant revised

video packet 110 is output to the buffer 7c.

        Every time the video packet is input

10   from the data demultiplexer 41, the aforementioned

process is repeated by the CRC character isolating

unit 42, the CRC calculating unit 43 and the error

information adding unit 44 so that the revised

video packet 110 is output to the buffer 7c.

15   Assuming that the video decoder 5 is

informed that error information 105 is provided at

the head of the revised video packet 110, the

video decoder 5 can determine whether error

propagation occurs on a packet by packet basis

20   before decoding the video data comprising the

revised video packet 110 stored in the buffer 7c

and provided with the error information. This is

achieved by receiving the video packet 110 in the

order of occurrence and by referring to the error

25   information attached to the video packet 110 every

time the video packet 110 occurs.

        Since the video decoder 5 is given

information as to whether an error occurs in each

video packet 110 before decoding the video data by

30   referring to the error information, it is ensured

that the video packet 110 containing the error is
not decoded.

Accordingly, the decoding process of the
video decoder 5 is prevented from being wasted.

5   As a result, an error is prevented from being
propagated efficiently. Error concealment at
decoding using the error information according to
the invention may have several variations. For
example, the video packet containing an error may

10   be replaced by a previous video packet. Any type
of appropriate error containment may be applied to
the present invention.

Fig. 3 is a diagram showing how a video
packet is revised in the media demultiplexer

15   according to the first embodiment.

As shown in Fig. 3, the video packet 100
provided with a CRC character C1 is dissolved by
the CRC character isolating unit 42 into the video
packet 100 and the CRC character C1. The CRC

20   calculating unit 43 conducts a calculation which
is the same as the CRC calculation at the encoding
end whereby specific data comprising the video
packet 100 is subject to the calculation using a
predetermined polynomial. As a result, a result

25   of calculation C2 is output.

The error information adding unit 44
compares the CRC character C1 with the result of
calculation C2. When the CRC character C1 matches
the result of calculation C2, the error

30   information adding unit 44 adds error information

105, for example, numeral "0", indicating that there is no error, at the head of the video packet 100, that is, before the resync marker 01 of the video packet 100, producing the revised video

5   packet 110 different from the video packet 100. When the CRC character C1 does not match the result of calculation C2, the error information adding unit 44 adds the error information 105, for example, numeral "1", indicating that there is an

10 error, at the head of the video packet 110, that is, before the resync marker 110. According to the first embodiment, since the CRC character C1 is isolated by the CRC character isolating unit 42 from the video packet 100, the CRC character C1 is

15 not added to the revised video packet 110.

Fig. 4 is a diagram showing a revised video packet in which the error information 105 is added by the error information adding unit 44 according to the first embodiment. As shown in

20 Fig. 4, the error information 105 is added to precede the resync marker 101 of the video packet 110. According to the first embodiment of the present invention, an arrangement is set up between the media demultiplexer 4 and the video

25 decoder 5 that the error information 105 is added at the head of the revised video packet 110.

As described above, the first embodiment of the present invention is constructed such that the media demultiplexer 4 preceding the video

30 decoder 5 checks each of the video packets

constituting the video data for an error.
Therefore, the video encoder 5 is given
information relating to an error in each of the
video packets constituting the video data before
5   decoding the video data so that the video encoder
5 can efficiently prevent an error from being
propagated, thus improving tolerance to error.

The first embodiment of the present
invention is described as being provided with the
10   CRC character isolating unit 42 for isolating the
CRC character C1 from the video packet 100.
Alternatively, the CRC character isolating unit 42
may be eliminated. With this construction, the
video packet 100 provided with the CRC character
15   C1 is fed directly from the data demultiplexer 41
to the CRC calculating unit 43 and the error
information adding unit 44, causing the CRC
character C1 to remain contained in the revised
video packet 110. Elimination of the CRC
20   character isolating unit 42 is advantageous in
that the construction is simplified and the
process is facilitated.

Second Embodiment
25   In the first embodiment, the error
information adding unit 44 adds the error
information to precede the resync marker of the
video packet in which an error occurs before
delivering the data to the video decoder.
30   According to the second embodiment, the error

information is added to precede the resync marker

of a subsequent video packet 120. The

construction of the multimedia communication

apparatus according to the second embodiment is

5   the same as the corresponding construction of the

first embodiment. Therefore, only the

construction of the video data comprising the

revised video packet will now be described.

Fig. 5 is a diagram showing the revised

10   video packet 120 in which error information is

added by the error information adding unit 44

according to the second embodiment of the present

invention. As shown in Fig. 5, according to the

second embodiment, the error information 105 is

15   added subsequent to the stuff bit 104 at the end

of each video packet 120. The error information

indicating an error in the given video packet 120

is added to precede the resync marker 101 of the

subsequent video packet 120. A stream comprising

20   the resync marker 101 at its head and the error

information 105 at its end constitutes the revised

video packet 120.

Thus, the second embodiment provides an

advantage similar to the advantage provided by the

25   first embodiment in that the information relating

to an error in each video packet 120 is available

before the video decoder 5 performs a decoding

process, thereby preventing error propagation and

improving error tolerance.

30   In the first embodiment, the error

information 105 is added at the head of the video

packet 110. The error information adding unit 44

stores the video packet 110 in the internal buffer

until the error information 105 is added to the

5 video packet 110. The second embodiment differs

from the first embodiment in that the error

information is added at the end of the subsequent

video packet 120, that is, added to precede the

resync marker 101 of each video packet 120. The

10 error information 105 is output after the video

packet 120 is output. Consequently, according to

the second embodiment, the error information

adding unit 44 is not required to store the video

packet 120 in the internal buffer. The memory

15 required to be attached to the error information

adding unit 44 in the first embodiment is not

necessary so that the construction is simplified.

In the first and second embodiments, the

error information 105 is described as being

20 provided to precede the resync marker 101 of the

current video packet or the subsequent video

packet. Alternatively, the error information 105

may also be provided subsequent to the resync

marker 101.

25

Third Embodiment

As described above, in the first and

second embodiments, an arrangement is set up

between the media demultiplexer 4 and the video

30 decoder 5 that the error information is provided

to precede or succeed the current video packet.
The arrangement may also be that the error
information is provided to precede or succeed the
previous video packet. In contrast, according to
5   the third embodiment, the error information is
provided at any desired location other than a
location preceding or succeeding the resync marker
101. The construction of the multimedia
communication apparatus according to the third
10   embodiment is the same as the corresponding
construction of the first embodiment. Therefore,
only the construction of the revised video data
comprising the video packet will now be described.

Fig. 6 is a diagram showing a location
15   and configuration of error information added by
the error information adding unit according to a
third embodiment of the present invention.

As shown in Fig. 6, the error
information 105 is not provided to precede the
20   resync marker 101. Instead, the error information
105 may be provided to precede the macro block
(MB) coded information 103. More specifically, a
fixed-length code comprising a unique bit pattern
such as a unique word 105a comprising, for example,
25   a reserved code 000001C5 of an MPEG4 header is
followed by an error information container 105b
which contains the error information 105.

In the case of the first and second
embodiments, the error information 105 is provided
30   to precede or succeed the resync marker 101, that

is, provided to precede or succeed a codeword
comprising a unique bit pattern that does not
match any of the combinations of the variable-
length codes occurring in the bit stream. Given

5   that the video decoder 5 is given the information
that the error information 105 is provided to
precede or succeed the resync marker 101, it is
ensured that the video decoder 5 recognizes the
error information 105. In contrast, in the third

10 embodiment, the video decoder 5 is not given any
information relating to where the error
information 105 is provided and therefore cannot
locate the error information unless the measure
described above is employed. In other words, by

15 containing the error information 105 in the error
information container 105b led by the unique word
105a, the fixed-length code comprising a unique
bit pattern, and giving the video encoder 5 the
information that the error information 105 is led

20 by the unique word 105a, it is ensured that the
video decoder 5 recognizes the error information
105.

Accordingly, the error information 105,
appended to the video packet 110 through the media

25 demultiplexer 4, is led by the unique word 105a.
The video decoder 5 can successfully detect the
error information 105, by detecting the unique
word 105a, even if the error information 105 is
provided in an arbitrary location other than the

30 immediate neighborhood of the resync marker 101 of

the video packet and even if the location of the error information is not known to the video decoder 5.

The first and second embodiments may
5 also be constructed such that the unique word 105a leads the error information, as in the third embodiment.

Fig. 7A is a diagram showing the error information according to the first embodiment in
10 which the construction of error information according to the third embodiment is employed.

Fig. 7B is a diagram showing the error information according to the second embodiment in which the construction of error information
15 according to the third embodiment is employed.

Referring to Fig. 7A, according to the first embodiment, the error information 105 is provided to precede the resync marker 10 of the current video packer 110. A fixed-length code
20 comprising a unique bit pattern such as the unique word 105a comprising, for example, a reserved code 000001C5 of an MPEG4 header leads the error information container 105b which contains the error information 105.

25 Referring to Fig. 7B, according to the second embodiment, the error information 105 is provided to precede the resync marker 101 of the subsequent video packet 110. A fixed-length code comprising a unique bit pattern such as the unique
30 word 105a comprising, for example, a reserved code

000001C5 of an MPEG4 header leads the error information container 105b which contains the error information 105.

The resultant construction of the video data is more redundant than the corresponding construction of the video packet 110 and video packet 120 according to the first embodiment alone and the second embodiment alone, respectively. However, unlike the first and second embodiments alone, the video decoder 5 can easily detect the error information 105 of the video packet, even when the video decoder 5 is not given the information that the error information generated by the media demultiplexer 4 is provided to precede or succeed the resync marker 101 of the video packet. An advantage of the arrangements of Figs. 7A and 7B over the third embodiment shown in Fig. 6 is that, like the first and second embodiments alone, the error information 105 is not found between the resync marker 101 at the head of the video packet and the stuff bit 104 at the end thereof, the construction of the video packet remains the same as that of the related art, facilitating the video decoder 5 to process the video packet without employing any special measures.

In the description given above of the first through third embodiments, the data demultiplexer 41, the CRC character isolating unit 42, the CRC calculating unit 43 and the error

information adding unit 44 are described as being

included in the media demultiplexer 4.

Alternatively, these units may also be provided

outside the media demultiplexer 4 as long as these

5   units are provided to precede the video decoder 5.

It is to be appreciated that, according

to the present invention, each video packet is

checked by the media demultiplexer for an error,

before the decoding process by the video decoder.

10 Therefore, the decoding process of the video

decoder is prevented from being wasted. Error

detection and error correction can be conducted

efficiently so that the high-quality image

reproduction is smoothly available.

15 The present invention is not limited to

the above-described embodiments, and variations

and modifications may be made without departing

from the scope of the present invention.